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EXAMINER

MALDONADO, JULIO J

ART UNIT

PAPER NUMBER

2823

NOTIFICATION DATE

DELIVERY MODE

12/17/2009

ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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### Office Action Summary

**Application No.**

10/613,203

**Applicant(s)**

SANDHU ET AL.

**Examiner**

JULIO J. MALDONADO

**Art Unit**

2823

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 September 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-13, 52, 53 and 60-70 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-13, 52, 53, and 60-70 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB06)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-13, 52, 53, and 60-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takehiro et al. (U.S. 6,403,441 B1, hereinafter Takehiro) in view of Fazan et al. (U.S. 5,392,189, hereinafter Fazan).

In reference to claims 1 and 3, Takehiro (Figs.2d, 4a and 4b) discloses a substrate assembly, comprising a support surface (6) having uniform composition; and a plurality of high-K dielectric layers (9, 10, 11) over said support surface, wherein a common metal is present in said layers of said plurality (9, 10, 11), and wherein one of the layers has a higher concentration of oxygen defined by point A (Takehiro Fig.4b) than an underlying layer, defined by point B (Takehiro, Fig.4b), wherein said plurality high-k dielectric layers (9, 10, 11) further includes an oxygen barrier layer (10) that prevents oxides of the support surface (6) and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 4, lines 46 – 54, column 6, line 16 – column 8, line 27 and column 16, lines 29 – 35).

Takehiro fails to expressly disclose wherein one layer of the plurality of high-k dielectric layers manifests greater oxidation than would an equivalent thickness of an underlying layer of the plurality.

However, the recitation of "greater oxidation" is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a higher concentration of oxygen.

Still, Takehiro fails to disclose a support surface having a uniform composition and extending into a recess formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (KSR International Co. v. Teleflex Inc., 82 USPQ2d 1385 (U.S. 2007)).

In reference to claim 2, the combination of Takehiro and Fazan discloses wherein said plurality of high-K dielectric layers comprise a first high-k dielectric contacting said support surface (Takehiro, column 7, lines 53 – 65).

In reference to claim 4, the combination of Takehiro and Fazan discloses wherein said support surface is a capacitor electrode (Takehiro, column 7, lines 30 – 36).

In reference to claims 5-7, the combination of Takehiro and Fazan discloses wherein the one of the dielectric layers defines a thickness of, for example, 10 nm and another of the dielectric layers defines a thickness of, for example, 40 nm, and wherein the invention is not restricted to these examples (Takehiro, column 16, lines 17 – 35).

The combination of Takehiro and Fazan fails to expressly disclose wherein said plurality of high-k dielectric layers defines a thickness of at most 200 angstroms; wherein said plurality of high-k dielectric layers comprises a first high-k dielectric layer contacting said support surface and defining a thickness of at least a monolayer;

wherein said first high-k dielectric layer defines a thickness of at least 10 angstroms; wherein the plurality of capacitor dielectric layers defines a total thickness that ranges between approximately 50 angstroms and approximately 70 angstroms; wherein each layer of the plurality defines an individual layer thickness that ranges between approximately 10 angstroms and approximately 40 angstroms; and wherein at least a lowest layer of the plurality defines an individual thickness of approximately 20 angstroms.

One of ordinary skill in the art would have been led to the recited dimensions through routine experimentation and optimization to obtain a desired plurality of dielectric layers. Applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension (Instant specification, page 10, line 13 – page 11, line 4). Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966). See also MPEP 2144.04(IV)(B).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable the combination of Takehiro and Fazan to arrive at the claimed invention through routine optimization.

In reference to claim 8, Takehiro discloses a capacitor dielectric including a plurality of high-k dielectric layers (9, 10, 11), wherein said plurality of high-k dielectric layers further includes a first high-k dielectric layer having a first oxygen concentration defined by point A (Takehiro, Fig.4b) and a second high-k dielectric layer having a second oxygen concentration defined by point B (Takehiro, Fig.4b), which is lower than said first oxygen concentration (Takehiro, column 4, lines 46 – 54 and column 6, line 16 – column 8, line 27). Furthermore, Takehiro discloses wherein the plurality of high-k dielectric layer (9, 10, 11) further comprises an oxygen diffusion barrier layer (10) that prevents oxides in a support surface (6) having a uniform composition (Takehiro, column 4, lines 45 – 54) and a conductive layer (8) spaced apart from the support surface wherein the first high-k dielectric layer and the second high-k dielectric layer abut the support surface (6) and the conductive layer (8), and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 16, lines 29 – 35).

Takehiro fails to expressly disclose wherein the first high-k dielectric layer manifests a greater oxidation than would an equivalent thickness of the second high-k dielectric layer.

However, the recitation of "greater oxidation" in claim 8 is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro discloses the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower concentration.

Still, Takehiro fails to disclose wherein the support surface and the conductive layer extend into a recesses formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for



the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (KSR International Co. v. Teleflex Inc., 82 USPQ2d 1385 (U.S. 2007)).

In reference to claim 9, the combination of Takehiro and Fazan discloses wherein said first high-k capacitor dielectric and said second high-k capacitor dielectric have different thicknesses (Takehiro, column 7, line 53 - column 8, line 27).

In reference to claim 10, the combination of Takehiro and Fazan discloses wherein said first high-k capacitor dielectric and said second high-k capacitor dielectric are oxides (Takehiro, column 7, line 53 - column 8, line 27 and column 15, lines 57 – 67).

In reference to claim 11, the combination of Takehiro and Fazan discloses wherein said first high-k capacitor dielectric is a first oxide with a first oxygen concentration and wherein said second high-k capacitor dielectric is a second oxide different from said first oxide (Takehiro, Fig. 4). Therefore, since the first and the second layer have different oxygen composition, for purposes of this rejection, this is seen as a first layer being different than a second layer.

In reference to claim 12, Takehiro (Figs.2d, 4a and 4b) discloses a capacitor dielectric (9, 10, 11) comprising a first high-k capacitor dielectric comprising a metallic element and contains a first amount of oxygen per unit volume defined by point A (Takehiro, Fig.4a); a second high-k capacitor dielectric comprising said metallic element

and contacting said first high-k capacitor dielectric, wherein said second high-K capacitor dielectric contains a second amount of oxygen per unit volume defined by point B (Takehiro, Fig.4c) different from said first amount, wherein said first high-K capacitor dielectric and said second high-K capacitor dielectric are oxides, wherein said capacitor dielectric (9, 10, 11) further includes a oxygen diffusion barrier layer (10) resulting in a surface of a lower electrode (6) to be free of oxides, the surface of the lower electrode having uniform composition; and a conductive layer (8) spaced apart from the support surface (6), wherein said capacitor dielectric (9, 10, 11) abut the support surface (6) and the conductive layer (8) and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 4, lines 46 – 54, column 6, line 16 – column 8, line 27 and column 16, lines 29 – 35).

Takehiro fails to expressly disclose wherein the first high-k capacitor dielectric manifests a greater oxidation than would an equivalent thickness of the second high-k capacitor dielectric.

However, the recitation of “greater oxidation” is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower concentration.

Still, Takehiro fails to disclose, wherein the support surface having uniform composition extends into a recess formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (KSR International Co. v. Teleflex Inc., 82 USPQ2d 1385 (U.S. 2007)).

In reference to claim 13, Takehiro (Figs.2d, 4a and 4b) teaches a capacitor structure, comprising a first electrode layer (6) having a uniform composition; a dielectric

layer (9, 10, 11) disposed over said first electrode layer (6), wherein said dielectric layer (9, 10, 11) comprises a plurality of consecutively-positioned sub-layers, wherein each of said sub-layers comprises a high-dielectric-constant material, wherein said dielectric layer comprises an element common to all sub-layers of said plurality, wherein the dielectric layer (9, 10, 11) further includes a oxygen diffusion barrier layer (10) that prevents oxides to be formed in said first electrode layer (6) wherein one of said sub-layers has more oxygen, defined by point A (Takehiro, Fig.4b) than another of said sublayers defined by point B (Takehiro, Fig.4b); and a second electrode layer (8) disposed over said dielectric layer (9, 10, 11), wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 4, lines 46 – 54, column 6, line 16 – column 8, line 27 and column 16, lines 29 – 35).

Takehiro fails to expressly disclose wherein one of the sub-layers of the dielectric layer manifests greater oxidation than would an equivalent thickness of an underlying sub-layer of the dielectric layer further

However, the recitation of “greater oxidation” is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower concentration.

Still, Takehiro fails to disclose, wherein the first electrode having said uniform composition and the second electrode extend into a recesses formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary

skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (KSR International Co. v. Teleflex Inc., 82 USPQ2d 1385 (U.S. 2007)).

In reference to claims 52, 53 and 62, Takehiro (Figs.2d, 4a and 4b) discloses a capacitor structure, including a first electrode (6) having a uniform composition, a capacitor dielectric and a second electrode (8), wherein said second electrode (8) is spaced apart from the first electrode and said capacitor dielectric abuts said first (6) and second (8) electrode, wherein said capacitor dielectric comprises a plurality of capacitor dielectric layers (9, 10, 11), wherein each layer of said plurality is a high-K dielectric defining an individual thickness, wherein at least one layer of the plurality has a greater concentration of oxygen (Fig.4b, Point A) than an underlying layer (Figs.4b, Point B), and wherein said capacitor dielectric (9, 10, 11) further includes an oxygen barrier layer (10) that prevents oxides from forming in a support surface (6) (Takehiro, column 4, lines 46 – 54 and column 6, line 16 – column 8, line 27). Furthermore, Takehiro discloses wherein the one of the dielectric layers (9) defines a thickness of, for example, 10 nm and another of the dielectric layers (11) defines a thickness of, for example, 40 nm, and wherein the invention is not restricted to these examples (Takehiro, column 16, lines 17 – 35), and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 16, lines 29 – 35).

Takehiro fails to expressly disclose wherein at least one layer of the plurality manifests a greater oxidation than would an equal thickness of an underlying layer of the plurality.

However, the recitation of "greater oxidation" is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower concentration.

Still, Takehiro fails to disclose, wherein the first and second electrodes extend into a recesses formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for

the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (*KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007)).

Still, the combination of Takehiro and Fazan fails to expressly disclose wherein said plurality of capacitor dielectric layers defines a total thickness ranging from 50 to 70 angstroms, wherein each layer of said plurality defines an individual thickness ranging from 10 to 40 angstroms in thickness, and wherein at least a lowest layer of said plurality defines an individual thickness of about 20 angstroms.

One of ordinary skill in the art would have been led to the recited dimensions through routine experimentation and optimization to obtain a desired plurality of dielectric layers. Applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears *prima facie* that the process would possess utility using another dimension (Instant specification, page 10, line 13 – page 11, line 4). Indeed, it has been held that mere dimensional limitations are *prima facie* obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S.



830, 225 USPQ 232 (1984); In re Dailey, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

See also MPEP 2144.04(IV)(B).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable the combination of Takehiro and Fazan to arrive at the claimed invention through routine optimization.

In reference to claims 60 and 61, the combination of Takehiro and Fazan disclose wherein the at least two layers of said plurality include barium strontium and titanium (Takehiro, Figs.4a-4b).

In reference to claim 63, Takehiro (Figs.2d, 4a and 4b) discloses a capacitor structure, including a first electrode (6) having a uniform composition, a capacitor dielectric and a second electrode (8), wherein said second electrode (8) is spaced apart from the first electrode and said capacitor dielectric abuts said first (6) and second (8) electrode, wherein said capacitor structure comprises a plurality of capacitor dielectric layers (9, 10, 11), wherein each layer of the plurality is a high-K dielectric, wherein at least one layer of the plurality has a greater concentration of oxygen (Fig.4b, Point A) than an underlying layer (Figs.4b, Point B), wherein said capacitor dielectric (9, 10, 11) further includes an oxygen barrier layer (10) that prevents oxides from forming in a support surface (6), and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 4, lines 46 – 54, column 6, line 16 – column 8, line 27 and column 16, lines 29 – 35)

Takehiro fails to expressly disclose wherein one of the sub-layers of the dielectric layer manifests greater oxidation than would an equivalent thickness of an underlying sub-layer of the dielectric layer further

However, the recitation of "greater oxidation" is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower oxygen concentration.

Still, Takehiro fails to disclose, wherein the first electrode and the second electrode extend into a recesses formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is prima facie obvious to combine equivalents known for the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (KSR International Co. v. Teleflex Inc., 82 USPQ2d 1385 (U.S. 2007)).

In reference to claims 64-66, the combination of Takehiro and Fazan discloses wherein the one of the dielectric layers defines a thickness of, for example, 10 nm and another of the dielectric layers defines a thickness of, for example, 40 nm, and wherein the invention is not restricted to these examples (Takehiro, column 16, lines 17 – 35).

The combination of Takehiro and Fazan fails to expressly disclose wherein said plurality of high-k dielectric layers defines a thickness of at most 200 angstroms; wherein said plurality of high-k dielectric layers comprises a first high-k dielectric layer contacting said support surface and defining a thickness of at least a monolayer; wherein said first high-k dielectric layer defines a thickness of at least 10 angstroms; wherein the plurality of capacitor dielectric layers defines a total thickness that ranges between approximately 50 angstroms and approximately 70 angstroms; wherein each layer of the plurality defines an individual layer thickness that ranges between approximately 10 angstroms and approximately 40 angstroms; and wherein at least a

lowest layer of the plurality defines an individual thickness of approximately 20 angstroms.

One of ordinary skill in the art would have been led to the recited dimensions through routine experimentation and optimization to obtain a desired plurality of dielectric layers. Applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension (Instant specification, page 10, line 13 – page 11, line 4). Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966). See also MPEP 2144.04(IV)(B).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable the combination of Takehiro and Fazan to arrive at the claimed invention through routine optimization.

In reference to claim 67, Takehiro (Figs.2d, 4a and 4b) discloses a capacitor structure, including a first electrode (6) having a uniform composition, a capacitor dielectric and a second electrode (8), wherein said second electrode (8) is spaced apart from the first electrode and said capacitor dielectric abuts said first (6) and second (8)

electrode, wherein said capacitor dielectric comprises a plurality of capacitor dielectric layers (9, 10, 11), wherein each layer of the plurality is a high-K dielectric, wherein at least one layer of the plurality has a greater concentration of oxygen (Fig.4b, Point A) than an underlying layer (Figs.4b, Point B), wherein said capacitor dielectric (9, 10, 11) further includes an oxygen barrier layer (10) that prevents oxides from forming in said first electrode (6), and wherein the invention may be carried out in any semiconductor device as long as it has a capacitor structure that employs a highly dielectric film as an insulating film (Takehiro, column 4, lines 46 – 54, column 6, line 16 – column 8, line 27 and column 16, lines 29 – 35)

Takehiro fails to expressly disclose wherein at least one layer of the plurality manifests a greater oxidation than would an equal thickness of an underlying layer of the plurality.

However, the recitation of “greater oxidation” is seen to be a recitation of a dielectric layer of said plurality of layers having a higher concentration of oxygen with respect to another layer of said plurality. Therefore, Takehiro teaches the claimed limitation because Takehiro discloses an overlying dielectric layer having a lower concentration.

Still, Takehiro fails to disclose wherein the first and second electrodes extend into a recesses formed in the substrate assembly.

However, Fazan (Figs.14A-15B) discloses a substrate assembly including a support surface (85) having a uniform composition and wherein in one embodiment, the support surface (85) extend into a recess formed in a substrate assembly, and wherein

in another embodiment, the support surface (85) does not extend into a recess; a high-k dielectric layer (87) over said support surface (85); and a conductive layer (89) spaced apart from the support surface (85) and abutting said high-k dielectric layer (87) and said support surface (89), wherein in one embodiment said support surface (85) and said conductive layer (89) do not extend into a recess formed in a substrate, and wherein in a second embodiment said support surface (85) and said conductive layer (89) extend into a recess formed in the substrate assembly (Fazan, column 7, line 7 – column 8, line 64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Takehiro and Fazan to enable substituting the support substrate of Takehiro with an equivalent support substrate as disclosed in Fazan, because is *prima facie* obvious to combine equivalents known for the same purpose (see MPEP 2144.06, I and II), and furthermore, because variations of particular work available in one field of endeavor may be prompted by design incentives and other market forces, either in same field or different one, and if person of ordinary skill in art can implement predictable variation, 35 U.S.C. §103 likely bars its patentability (*KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007)).

In reference to claims 68-70, the combination of Takehiro and Fazan discloses wherein the one of the dielectric layers defines a thickness of, for example, 10 nm and another of the dielectric layers defines a thickness of, for example, 40 nm, and wherein the invention is not restricted to these examples (Takehiro, column 16, lines 17 – 35).

The combination of Takehiro and Fazan fails to expressly disclose wherein said plurality of high-k dielectric layers defines a thickness of at most 200 angstroms; wherein said plurality of high-k dielectric layers comprises a first high-k dielectric layer contacting said support surface and defining a thickness of at least a monolayer; wherein said first high-k dielectric layer defines a thickness of at least 10 angstroms; wherein the plurality of capacitor dielectric layers defines a total thickness that ranges between approximately 50 angstroms and approximately 70 angstroms; wherein each layer of the plurality defines an individual layer thickness that ranges between approximately 10 angstroms and approximately 40 angstroms; and wherein at least a lowest layer of the plurality defines an individual thickness of approximately 20 angstroms.

One of ordinary skill in the art would have been led to the recited dimensions through routine experimentation and optimization to obtain a desired plurality of dielectric layers. Applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension (Instant specification, page 10, line 13 – page 11, line 4). Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S.

830, 225 USPQ 232 (1984); In re Dailey, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

See also MPEP 2144.04(IV)(B).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable the combination of Takehiro and Fazan to arrive at the claimed invention through routine optimization.

### ***Response to Arguments***

3. Applicant's arguments with respect to claims 1-13, 52, 53, and 60-70 have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of



the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JULIO J. MALDONADO whose telephone number is (571)272-1864. The examiner can normally be reached on Mon-Fri, 8:00 A.M.-4:00 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571)-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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